Course Title: Operational Research (3 Cr.)
Course Code: CAOR451
Year/ Semester: IV/VIII
Class Load: 4Hrs. /Week (Theory: 3 Hrs. Tutorial: 1 Hrs)

Course Description

Operations Research is the study of scientific approaches to decision-making. Through mathematical modeling, it seeks to design, improve and operate complex systems in the best possible way. The mathematical tools used for the solution of such models are either deterministic or stochastic, depending on the nature of the system modeled. In addition, the course will learn very powerful modeling and solution techniques for decision-making problems that are used today by many successful companies to help them save/earn millions of dollars. The module covers topics that include: linear programming, transportation, assignment, inventory control, replacement theory and game theory. Analytic techniques and computer packages will be used to solve problems facing business managers in decision environments

Course Objectives

The general objectives of this course to provide a broad orientation of the field of optimization, with emphasis on basic theory and methods for continuous and discrete optimization problems in finite dimension, and it also gives some insight into its use for analyzing practical optimization problems.

Unit 1: Introduction to Operations Research **5 hrs.**

Introduction, History of Operations Research, Stages of Development of Operations Research Relationship between Manager and OR Specialist, OR Tools and Techniques, Applications of Operations Research, Limitations of Operations Research

Unit 2: Linear Programming Problem **10 hrs.**

Introduction to Linear Programming, Linear Programming Problem Formulation, Formulation with Different Types of Constraints, Graphical Analysis of Linear Programming, Graphical Linear Programming Solution, Multiple Optimal Solutions, Unbounded Solution, Infeasible Solution, Basics of Simplex Method, Simplex Method Computation, Simplex Method with More Than Two Variables, Primal and Dual Problems, Economic Interpretation

Unit 3: Transportation and Assignment Problem **8 hrs.**

Transportation Problems definition, linear form, Solution methods: North West corner method, least cost method, Vogel's approximation method. Degeneracy in transportation, Modified Distribution method, unbalanced problems and profit maximization problems. Transshipment Problems. Assignment Problem Structure and Solution: Short-Cut Method (Hungarian Method), Unbalanced Assignment Problem, Infeasible Assignment Problem, Maximization in an Assignment Problem, Crew Assignment Problem.

Unit 4: Queuing Theory **6 hrs.**

Basis of Queuing theory, elements of queuing theory, Kendall's Notation, Operating characteristics of a queuing system, Classification of Queuing models.

Unit 5: Inventory Control **6 hrs.**

Inventory classification, Different cost associated to Inventory, Economic order quantity, Inventory models with deterministic demands, ABC analysis.

Unit 6: Replacement theory **6 hrs.** Introduction, Replacement of capital equipment which depreciated with time, replacement by alternative equipment, Group and individual replacement policy

Unit 7: Game Theory **7 hrs.**

Introduction, Characteristics of Game Theory, Two Person, Zero sum games, pure strategy. Dominance theory, Mixed strategies (2x2, mx2), Algebraic and graphical methods

Teaching Methods

The general teaching pedagogy includes class lectures, presentations, group works, case studies, guest lecturers research works, project works, assignments (Theoretical and Practical). The teaching faculty will determine the choice of teaching pedagogy and encouraged to select software tools as per the requirements of topics for practical activities.

References/ Suggested Readings:

Hillier, F.S.& Lieberman, G.J. (1995). Introduction to Operations Research,7th edition. The McGraw-Hill Companies, Inc.

Natarajan, A. M.; Balasubramani, P. & Tamilarasi, A. (2007). Operations Research. Pearson Education Inc.

Sharma, J.K. (2009). Operational Research: Theory and Application. Macmillan Publishers India Ltd.

Taha, H.A. (2017). Operations Research: A Introduction, 10th edition, Global edition, Pearson Education, Inc. Pearson Prentice Hall.

Wagner, H. N. (2003). Operations Research by, Prentice hall. N D Vohra, Tata McGraw-Hill.

Winston, L.W. (2004). Operations Research: Applications and Algorithms, Indian University, 4th edition.

Evaluation

Examination Scheme				
Internal Assessment		**External Assessment**		**Total**
Theory	**Practical**	**Theory**	**Practical**	
40		**60**		**100**

Course Title: Multimedia System
Course Code: CACS457
Year/Semester: IV/VIII
Class Load: 5 Hrs. / Week (Theory: 3Hrs. Practical: 2 Hrs.)

Course Description

This course offers detailed concept and structure of Multimedia system. It includes introduction, Sound & Audio System, Images and Graphics, Video and Animation, Data Compression, Abstractions for programming , Multimedia design and applications . It does not entirely focus on theoretical concept but also strongly focuses on practical skill based learning

Course objectives

The general objectives of this course are to provide theoretical as well as practical knowledge of Multimedia System, applications and tools to make students capable of implementing, managing and developing the issues of multimedia application in their personal as well professional life.

Course Contents

Unit 1: Introduction **(6 Hrs)**

1.1 Multimedia and its applications
1.2 Global structure of Multimedia
1.3 Medium
1.4 Multimedia system and properties
1.5 Characteristics of a Multimedia system
1.6 Challenges for Multimedia Systems
1.7 Components of Multimedia System
1.8 Multimedia building blocks
1.9 Scope of Multimedia

Unit 2: Sound / Audio System **(5Hrs)**

2.1 Overview sound system
2.2 Producing digital audio
2.2 Music and speech
2.3 Speech Generation
2.4 Speech Analysis
2.5 Speech Transmission
2.6 Representation of audio files
2.7 Computer Music –MIDI
2.8 MIDI versus Digital Audio

Unit 3: Images and Graphics **(5 Hrs)**

3.1 Uses of images and Graphics
3.2 Digital Image Representation
3.3 Image and graphics Format
3.4 Working with image and graphics
3.5 Image Synthesis , analysis and Transmission

Unit 4: Video and Animation **(6 Hrs)**

4.1 Digital Video
4.2 Video signal representation
4.3 Computer Video Format
4.4 Computer- Based animation
4.5 Animation Language
4.6 Timeline and frame based animation
4.7 Timeline and Tween-Based animation

4.8 Methods of controlling Animation
4.9 Display of Animation
4.10 Transmission of Animation

Unit 5: Data Compression **(8 Hrs)**

5.1 Need for Data Compression
5.2 Compression Basics
5.3 Storage Space
5.4 Coding Requirements
5.5 Lossless and Lossy Compression techniques
5.6 Source, Entropy and Hybrid Coding
5.7 Lossy Sequential DCT- based Mode
5.8 Expanded Lossy DCT-based Mode
5.9 JPEG and MPEG Compression

Unit 6: Abstractions for programming **(6 Hrs)**

6.1 Abstractions Levels
6.2 Libraries
6.3 System Software
6.4 Toolkits
6.5 Higher Programming Languages
6.6 Object –oriented approaches

Unit 7: Multimedia design **(6 Hrs)**

7.1 Development phases and development teams
7.2 Analysis phase
7.3 Design Phase
7.4 Development phase
7.5 Implementation Phase
7.6 Evaluation and testing phase
7.7 Multimedia User Interface Design

Unit 8 : Multimedia Application **(6 Hrs)**

8.1 Media preparation and composition
8.2 Media integration and communication
8.2 Media Entertainment
8.4 Telemedicine
8.5 E-learning
8.6 Digital video editing and production systems
8.7 Video conferencing
8.8 Video-on-demand

Laboratory Works

Labs consist of at least 8 practical experiments and two assignments covering the topics of the syllabus.

Teaching Methods

The teaching faculties are expected to create environment where students can update and upgrade themselves with the current scenario of computing and information technology with the help of topics listed in the syllabus. The general teaching pedagogy that can be followed by teaching faculties for this course includes class lectures, laboratory activity, group discussions, case studies, guest lectures, research work, project work, assignments (Theoretical and Practical), and written and verbal examinations.

Evaluation

Examination Scheme				
Internal Assessment		**External Assessment**		**Total**
Theory	**Practical**	**Theory**	**Practical**	
20	**20 (3 Hrs.)**	**60 (3 Hrs.)**	**-**	

Text Books

1. Ralf Steinmetz and Klara Nahrstedt , Multimedia: Computing, Communications and Applications, Pearson Education Asia
2. John F. Koegel Buford , Multimedia Systems, Pearson Education Asia

Reference Books

1. Fred Halsall , Multimedia Communications, Applications, Networks, Protocols and Standards, Pearson Education Asia
2. Ralf Steinmetz and Klara Nahrstedt, Multimedia fundamentals, Pearson Education Asia

Course Title: **Machine Learning (3 Cr.)**
Course Code: **CACS456**
Year/Semester: **IV/VIII**
Class Load: **6 Hrs. / Week (Theory: 3Hrs. Practical: 3Hrs.)**

Course Description

This course presents comprehensive introduction to several topics on basic concepts and techniques of Machine Learning (ML). It also explores the understanding of the Supervised and unsupervised learning techniques, probability based learning techniques, performance evaluation of ML algorithms and applications of ML.

Course objectives

Upon completion of this course, students should be able to 1. Explain the concept of supervised, unsupervised and semi-supervised learning. 2. Develop algorithms to learn linear and non-linear models using software. 3. Perform creative work in the field machine learning to solve given problem.

Course Contents

	Hours
Unit 1: Introduction to machine learning History of machine learning, Brain-neuron learning system, Definition and types of learning, need of machine learning, Data and tools, review of statistics, training, validation and test data, theory of learning – feasibility of learning – error and noise – training versus testing, generalization bound – approximation-generalization tradeoff – bias and variance – learning curve	10
Unit 2 Introduction to Supervised Learning Classification problems, Linear Regression- Predicting numerical value, Finding best fit line with linear regression, Perceptron, learning neural networks structures, Decision tree representation, appropriate problems for decision tree learning, basic decision tree algorithm, support vector machines, Separating data with maximum margin, Finding the maximum margin,	11
Unit 3: Bayesian and instance based learning Probability theory and Bayes rule. Classifying with Bayes decision theory, Conditional Probability, Bayesian Belief Network, K-nearest neighbor	11
Unit 4:Introduction to un-supervised learning and dimensionality reduction Introduction to clustering, K- Mean clustering, different distance functions for clustering, Hierarchical clustering, Supervised learning after clustering, dimensionality reduction techniques, Principal component analysis	10
Unit 5: Measures for Performance Evaluation of ML algorithms Classification accuracy, Confusion matrix Misclassification costs, Sensitivity and specificity, ROC curve, Recall and precision, box plot, confidence interval	6

Evaluation

Evaluation Scheme

Internal Assessment		External Assessment		Total
Theory	Practical	Theory	Practical	100
20	20 (3 Hrs.)	60 (3 Hrs.)	-	

Laboratory Work

Laboratory work should be done covering all the topics listed above and a small project work should be carried out using the concept learnt in this course using software like matlab, python.

Text Books:

1. Tom M Mitchell, Machine Learning, First Edition, McGraw Hill Education, 2013.
2. Stephen Marsland, Machine Learning – An Algorithmic Perspective, Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.

Reference Books:

3. Peter Flach, Machine Learning: The Art and Science of Algorithms that Make Sense of Data, First Edition, Cambridge University Press, 2012.

Course Title: Knowledge Engineering (3 Cr.)
Course Code: CACS458
Year/Semester: IV/VIII
Class Load: 5 Hrs. / Week (Theory: 3Hrs. Practical: 2 Hrs.)

Course Description

This course offers detailed concept about knowledge representation, logic, reasoning and principles. It includes introduction, knowledge acquisition, knowledge representation and reasoning. It does not entirely focus on theoretical concept but also strongly focuses on practical skill based learning.

Course objectives

The general objectives of this course are to provide theoretical as well as practical knowledge of knowledge engineering to make students capable of analysis, design, implementing and managing of knowledge engineering in their personal as well professional life.

Course Contents

Unit 1: Introduction [6 Hrs.]
1.1 Overview of data. Information and knowledge
1.2 Knowledge engineering and Knowledge management
1.3 Artificial intelligence use in knowledge Engineering
1.4 Knowledge based system and its applications

Unit 2: Knowledge Acquisition [8 Hrs]
2.1 Information gathering
2.2 Information retrieval
2.3 Applications of Natural Language processing
2.3.1 Morphology, lexicon, syntax and semantics
2.3.2 Parsing, POS tagging, named entity tagging

Unit3: Machine Learning [12 Hrs]
3.1 Machine Learning and its applications
3.2 Supervised and unsupervised learning
3.3 Classification and clustering
3.4 Classification algorithms
3.4.1 Linear classifiers
3.4.2 nearest neighbor
3.4.3 Support Vector Machines
3.4.4 Decision tree
3.4.5 Random forest
3.4.6 Neural networks
3.4.7 Case based reasoning

Unit 4: Knowledge representation and reasoning [7Hrs]
4.1 Proposition logic, predicate logic and reasoning
4.2 Knowledge representation languages
4.3 Non-monotonic reasoning
4.4 Probabilistic reasoning

Unit 5: Ontology Engineering [6 Hrs]
5.1 Overview to Ontology
5.2 Classifications of ontology
5.3 Methodology use in Ontology

5.4 Ontology VS Language

Unit 6: Knowledge Sharing [9 Hrs]
6.1 Information Distribution and Integration
6.2 Semantic web and its applications
6.2.1 RDF and linked data
6.2.2 Description logic
6.2.3Web Ontology language
6.3 Social web and semantics

Laboratory Works
The practical work consists of all features of knowledge engineering and case studies.

Teaching Methods
The teaching faculties are expected to create environment where students can update and upgrade themselves with the current scenario of computing and information technology with the help of topics listed in the syllabus. The general teaching pedagogy that can be followed by teaching faculties for this course includes class lectures, laboratory activity, group discussions, case studies, guest lectures, research work, project work, assignments (Theoretical and Practical), and written and verbal examinations.

Evaluation

Examination Scheme				
Internal Assessment		External Assessment		Total
Theory	Practical	Theory	Practical	
20	20 (3 Hrs.)	60 (3 Hrs.)	-	

Text Books

3. Kendal, Simon, Creen, Malcolm, An Introduction to Knowledge engineering, Springer first edition, 2007
4. R.J. Brachman and H.J. Levesque. Knowledge representation and resoning (Elsevier 2004)

Reference Books

1. Stuart Russell and Peter Norvig, Artificial Intelligence: A modern approach (Prentice Hall edition , second edition, 2002)
2. P. Jackson, Introduction to expert systems, Addison Wesley, 1999.
3. John Debenham, Knowledge Engineering: Unifying Knowledge Base and Database Design , Springer , 1998

Course Name: Internet of Things (3 Cr.)
Course Code: CACS460
Year/Semester: IV/VIII
Class Load: 5 Hrs. / Week (Theory: 3Hrs. Practical: 2 Hrs.)

Course Description: The course introduces basics of IoT. It covers introductions of IoT, Devices and platform for developingIoT Systems, Design methodology, Data Analytics for IoT, Servers & Cloud offering and IoT system security.

Objective:
The objective of this course is to introduce the students about the principles, techniques, development and applications of IoT System.

Course Contents:

Unit 1: Introduction to IoT **[8Hrs.]**

1.1 Definition and Characteristics of IoT.
1.2 Physical and Logical Design of IoT.
1.3 IoT Enabled Technologies
1.4 IoT and M2M
1.5 Domain Specific IoTs: Home Automation, Cities, Environment, Energy, Retail, Logistics, Agriculture, Industry, Health and Lifestyle.

Unit 2: Sensor, Actuators and Interfacing **[18 Hrs.]**

2.1 Roles of Sensors and actuators, Types of sensors: Active and passive, analog and digital, Contact and no-contact, Absolute and relative
2.2 Working of sensors: Position, occupancy and motion, velocity and acceleration, force, pressure, flow, Acoustic, Humidity, light, radiation, temperature, chemical, biosensor, camera.
2.3 Development boards: Arduino and Raspberry pi installation, interfacing and programming using python.

Unit 3: IoT Platform Design Methodology **[6 Hrs.]**

Case Study on IoT System for Weather Monitor

Unit 4: Data and Analytics for IoT **[10Hrs.]**

4.1 An Introduction to Data Analytics for IoT
4.2 Machine Learning
4.3 Big Data Analytics Tools and Technology
4.4 Edge Streaming Analytics
4.5 Network Analytics

Unit 5: IoT Physical Servers and Cloud Offering **[3Hrs.]**

Cloud storage models and Communication APIs of IoT Systems

Unit 6: Securing IoT Systems **[3Hrs.]**

6.1 IoT Security Challenges
6.2 IoTSystem's Security Practices

Laboratory Work:

Implement the concept mentioned in the course using Python as a programming language, Arduino or Raspberry pi as a System board. All sensors mentioned in course should be implemented in a single project or separately to observe their working mechanism.

Evaluation:

Examination Scheme				
Internal Assessment		External Assessment		Total
Theory	Practical	Theory	Practical	
20	20	60	-	

Reference Books:

1. ArshdeepBahga, Vijay Madisetti, "Internet of Things (A Hands-on-Approach)", University Press India Pvt. Ltd., 2015.
2. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry,"IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", Pearson Education (Cisco Press Indian Reprint).
3. Raj Kamal, "Internet of Things: Architecture and Design Principles", McGraw Hill Education, 2017.
4. Gary Smart, "Practical Python Programming for IoT", ISBN-10: 1838982469
5. Gaston C. Hillar Internet of Things with Python, ISBN-10: 1785881388

Course Title: Geographical Information System (3 Cr.)
Course Code: CACS454
Year/Semester: IV/VIII
Class Load: 5 Hrs. / Week (Theory: 3Hrs. Practical: 2 Hrs.)

Course Description

This course offers detailed knowledge as well as practical skills on GIS theory, design and implementation. It includes introduction, GIS and Map, GIS data sources and structures, spatial data analysis, GIS data modeling and creating map apart from this this encourages to students to develop a real time basic GIS project.

Course objectives

The general objectives of this course are to provide theoretical knowledge as well as practical skills of geographical information system to make students capable of capturing, analyzing and visualize real world data.

Course Contents

Unit 1: Introduction **6 Hrs.**
- 1.1 Definition, functions and Applications of GIS
- 1.2 Components of GIS
- 1.3 GIS as Information System
- 1.4 Nature & Sources of GIS data
- 1.5 Recent trends and future of GIS

Unit 2: GIS and Map **8 Hrs.**
- 2.1 Map and their characteristics
- 2.2 Mapping concept and Techniques
- 2.3 Map Projection

Unit 3: GIS data Sources & Structures **12 Hrs.**
- 3.1 Capturing GIS data
- 3.2 Sources: Maps, GPS, Images and Databases
- 3.3 Structures: Vector, Raster and TIN data structures
- 3.4 GIS data modeling
- 3.5 GIS database design

Unit 4: Spatial Data Modeling and Analysis **12 Hrs.**
- 4.1 Spatial data modeling
- 4.2 Vector based analysis
- 4.3 Raster based analysis

Unit 5: GIS data modeling & Creating Maps **10 Hrs.**
- 5.1 Surface modeling
- 5.2 Hydrology modeling
- 5.3 Designing and printing the map

Laboratory Works

Students should develop basic GIS project implementing the concepts given in course of study and may add more (if required).

Teaching Methods

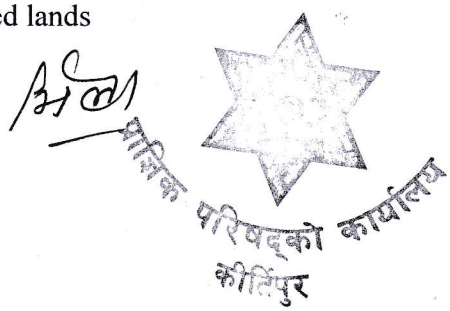
The teaching faculties are expected to create environment where students can update and upgrade themselves with the current scenario of computing and information technology with the help of topics listed in the syllabus. The general teaching pedagogy that can be followed by teaching faculties for this course includes class lectures, laboratory activity, group discussions, case studies, guest lectures, research work, project work, assignments (Theoretical and Practical), and written and verbal examinations.

Evaluation

Examination Scheme				
Internal Assessment		External Assessment		Total
Theory	Practical	Theory	Practical	
20	20 (3 Hrs.)	60 (3 Hrs.)	-	

Reference Books

1. Kang-tsung Chang, (2010). "Introduction to Geographic Information Systems" Tata McGraw Hill, New Delhi.
2. C.P.Lo and Albert K.W.Yeung (2006). "Concepts and Techniques of Geographic Information Systems" Prentice Hall of India, New Delhi.
3. Albert, C.T.L. and Yeung, K.W. (2002). "Concepts and Techniques of Geographical Information Systems", New Delhi: Prentice Hall.
4. Chakraborty, D. and Sahoo, R.N. (2007). Fundamentals of GIS. India: Viva Books.
5. ESRI guide to GIS analysis Andy Mitchell, ESRI press, Red lands



Elective Courses

Course Title: **Database Programming**
Course Code: **CACS453**
Year/Semester: **IV/VIII**
Class Load: **6 Hrs. /Week (Theory: 3Hrs, Practical 3Hrs.)**

Course Description
This course provides the comprehensive knowledge about database programming in relational database management system, which encompasses with overview of fundamental SQL statement, PL/SQL Block, Exception, Cursors, Record, Triggers, Procedures, Functions and Packages

Objectives: The general objectives of this course is to enhance advance programming skills in relational database management system.

Unit -1
Introduction of RDBMS **10 Hrs**
Overview of the Oracle Database Architecture, Familiar with SQL*Plus, SQL*Plus Commands (DESCRIBE, LIST, APPEND, CHANGE, INPUT, DEL, CLEAR BUFFER, Using Script Files), Accepting Values at Runtime, Overview of Fundamental SQL Fundamental Command (DDL, DML, DCL, Join and Subquery)

Unit -2
PL/SQL **13 Hrs**
PL/SQL Concepts, Architecture, Block structure, Executing PL/SQL Script, DBMS_OUTPUT.PUT_LINE Statement, substitution Variable feature, PL/SQL Language fundamentals, DML Statement in PL/SQL, Transaction Control in PL/SQL. Conditional Control (if, nested if, Case), Repetitive Control (While, for, simple loop, Nested, continue, loop label)

Unit -3 **5 Hrs**
PL/SQL Exception
Exception scope, user-defined exception, exception propagation, advance exception concepts (RAISE_APPLICATION_ERROR, EXCEPTION_INIT)

Unit -4
Database Cursors **5 Hrs**
Types of cursors, cursor loop, Nested cursors cursor for loops, parameterized cursors, Nested cursors

Unit -5
Database Triggers **5 Hrs**
Database Triggers BEFORE, AFTER Triggers, row and statement triggers, INSTEAD OF triggers

Unit -6
Record and procedures **5 Hrs**
Record (Record types, Nested record) Procedure (Block Structure, Anonymous Block, creating procedure, IN, OUT parameters in Procedure)
Unit-7

Functions and Package **5 Hrs**

Functions (creating and invoking function and optimizing function in execution, creating packages, extending the package, package instantiation and initialization,

Laboratory Works

Laboratory works should be done covering all the topics listed above and a small work should be carried out using the concept learnt in each unit in individual or group.

Teaching Methods

The general teaching pedagogy includes class lectures, group discussions, case studies, guest lectures, research work, project work, assignments (theoretical and practical), and examinations (written and verbal), depending upon the nature of the topics. The teaching faculty will determine the choice of teaching pedagogy as per the need of the topics.

References

1. Benjamin Rosenzweig, E. R. (2015). Oracle PL/SQL by Example. New Yourk: Prentice Hall.
2. Gupta, S. K. (2016). Advanced Oracle PL/SQL Developer's Guide . Birmingham: Packt Publishing.
3. Lex de Haan, T. G. (2014). Beginning Oracle SQL. Apress.
4. McLaughlin, M. (2014). Oracle Database 12c PL/SQL Programming. New Delhi: McGrawHill Education.

Course Title: **Data Analysis and Visualization (3 Cr.)**
Course Code: **CACS455**
Year/Semester: **IV/VIII**
Class Load: **5 Hrs. / Week (Theory: 3Hrs. Practical: 2Hrs.)**

Course Description

This course introduces to extend student's knowledge and practice in data analysis and visualization, software, and applications. It provides the board overview of techniques of the visualization process, detailed view of visual perception, the visualized data and the actual visualization, interaction and distorting techniques.

Course objectives

Upon completion of this course, students should be able to 1. Explain the concept of visualization in the processing and analysis of data. 2. Develop visualization methods and visualization systems using software applications. 3. Perform creative work in the field of visualization.

Course Contents

	Hours
Unit 1: Introduction to visualization Introduction of visual perception, Visual representation of data, Data Abstraction, Visual Encodings, Use of Color, Perceptual Issues, Information overloads	6
Unit 2: Creating visual representations Visualization reference model, Visual mapping, Visual analytics, Design of Visualization applications.	7
Unit 3: Non spatial data visualization Visualization of one, two and multi-dimensional data, Tabular data, quantitative values (scatter plot), Separate, Order, and Align (Bar, staked Bar, dots and line charts), Tree data, Displaying Hierarchical Structures, graph data, rules for graph drawing and labeling, text and document data, levels of text representation, visualizations of a single text document, word cloud, flow data Time series data, characteristics of time data, visualization time series data, mapping of time	15
Unit 4: Spatial Data Visualization Scalar fields, Isocontours (Topographic Terrain Maps), scalar volumes, Direct Volume Rendering(Multidimensional Transfer Functions) , Maps (dot, pixel), vector fields Defining Marks and Channels	10
Unit 5: Software tools and data for visualization The iris data set, The Detroit Data Set, The Breakfast Cereal Data Set, The Dow Jones Industrial Average Data Set (time series), MS spread sheet, Python, Matlab, Java, Tableau	10

Evaluation

Evaluation Scheme

Internal Assessment		External Assessment		Total
Theory	Practical	Theory	Practical	
20	20 (3 Hrs.)	60 (3 Hrs.)	-	100

Laboratory Work

Laboratory work should be done covering all the topics listed above and a small project work should be carried out using the concept learnt in this course using any one software tools mention in unit 5.

Text Books:

3. Fry, Visualizing Data. O'Reilly Media, 2008, ISBN 0596514557
4. Ware, Information Visualization: Perception for Design, 3rd ed. Morgan Kaufmann, 2012,

Reference Books:

5. Telea, Data Visualization: Principles and Practice. A. K. Peters, Ltd, 2007, ISBN 1568813066.